FARMERS' TRAINING AND ITS INFLUENCE ON ADOPTION OF IMPROVED DAIRY HUSBANDRY PRACTICES IN ARUMERU DISTRICT

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ABSTRACT

Farmers' training is intended at promoting uptake of knowledge and skills, changing of attitudes and making farmers achieve their aspirations. When improved husbandry practices are systematically and effectively delivered, farmers' training is known to enhance adoption of improved husbandry practices and finally social and economic development. This study was conducted to assess the influence of farmers' training on enhancing adoption of the improved dairy husbandry practices among trained farmers in Arumeru District, Tanzania. A cross-sectional survey design was applied in the study and data were collected from 140 trained dairy farmers. Specifically the study sought to identify improved dairy husbandry practices taught to smallscale dairy farmers; determine the extent to which taught improved dairy husbandry skills are practiced by farmers and determine socioeconomic factors influencing trained farmers to effectively practice improved dairy husbandry skills they learned. Results show that majority of trained farmers adopted and practiced proper hand milking and milk hygiene, established pastures and fodder crops, and were able to follow animal health management practices and were 79.9%, 76.4% and 75.1%, respectively. Again good housing, selection and use of improved breeds, proper feeds and feeding and record keeping were adopted by 71.4%, 61.1%, 60.8% and 49.4%, respectively. Sex, education level, off-dairy income generating activities, household size, land size and extension services significantly influenced the adoption of skills they learned at $p \leq 0.05$. It is recommended that training backstopping; follow ups and efforts to get farmers educated are intensified to foster the adoption of the taught improved dairy husbandry practices by trained dairy farmers.

DECLARATION

I, Balija Gregory Philip Luyombya, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has neither been submitted nor concurrently being submitted in any other institution.

_____ _____

Balija Gregory Philip Luyombya Date

The declaration above is confirmed by

_____ _____

Dr. Kizito Kayanda Mwajombe Date

(Supervisor)

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DEDICATION

This precious work is dedicated to my beloved parents the late Mr. Phillip Makonda Nyanda and late My Mom Elizabeth Missoji John Mpuya, who laid down the underpinning of my education which made me what I am today. This work is also dedicated to my lovely grandma the late Tecla Limi Godo whose courage, compassion and love was the source of brainwave for this work.

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LIST OF ABBREVIATIONS AND ACCRONYMS

ASDP	Agricultural Sector Development Programme
FAO	Food and Agriculture Organization
FTC	Farmers Training centers
GDP	Gross Domestic Product
HPI	Heifer Project International
HSS	Hans Seidel Foundation
IFAD	International Fund for Agricultural Development
KATC	Kilimanjaro Agricultural Training Centre
LITI	Livestock Training Institute
MAC	Ministry of Agriculture and Co-operative
NGOs	Non- Government organisations
NSGRP	National Strategy for Growth and Reduction of Poverty
SPSS	Statistical Package for Social Science
TFA	Tanganyika farmers Association
URT	United Republic of Tanzania
VIF	Variance Inflation Factors
WVT	World Vision Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Introduction and Background Information

Farmers' training refers to educational services for influencing farmers to adopt improved practices in crop and livestock production (Halakatti *et al.,* 2007). The concern is not only with the learning and securing adoption of a particular improved practice, but also it can successfully bring about certain changes in the outlook and attitude of dairy farmers and thereby making them capable of rendering farming tasks more effectively and efficiently; continually seek means of improving farming enterprise. A farmer being a rational decision maker normally strives for a better standard of living and seeks ways of adopting new technologies to accomplish the set goals (Murai and Singh, 2011).

As described by Umar and Kumar (2011), majority of rural dairy farmers in Africa have experience in rearing animals while relying on traditional husbandry practices which may be the cause of low production and productivity of the dairy animals, however, these coupled with inadequate knowledge and skills on improved dairy husbandry practices, constrains them from adopting improved practices.

Generally knowledge and practical skills provision through farmers' training is thought to create a favourable mental attitude for the acceptance of improved practices especially of information-intensive and management-intensive practices (Caswell *et al.,* 2001) on adoption. Additionally, education is considered to reduce the amount of complexity perceived in a technology thereby increasing its adoption.

According to FAO (2011) farmers' training aims at communicating information, knowledge and skills, replacing old attitudes by new ones, exchanging opinions and experiences and reducing the amount of perceived complexity in a technology thereby creating a desired change.

Effective dissemination of improved dairy husbandry practices through training is an important strategy for increasing adoption; it creates awareness and competence in the target audience about innovations (Thapa, 2003). Additionally, training in agriculture related practice improves farmers' ability to acquire accurate information, evaluate new production processes, use improved husbandry practices and understand and these benefits translates into adoption if a set of enabling factors and conditions exists to trained farmer (Adesina and Zinnah, 1993). When practice is improved and widely profitable, farmers' training may increase the probability of adoption as it enhances their ability to acquire, interpret and use information about such improved husbandry practice.

Farmers with no skills and know-how about certain improved husbandry practices have less probability of adopting new technologies that are introduced (Mugisha *et al.,* 2012).

Farmers' training equips farmers with improved practices, which help them to adopt and practice effectively the taught improved practices. The skills acquired through training helps the recipient to carry out an improved practice effectively and efficiently. If farmers are well trained in new practices, they may need minimal technical advice and outside backup support.

The ability of a dairy farmer to practice and generate more income from dairying largely depend on the effective adoption of improved dairy husbandry practices that leads to

increase productivity. Hence, called upon the development of the dairy industry which comes from various forms include farmers' training and extension services that are effective forms in which farmers can have the knowledge and skills to manage the sector so that it can effectively contribute to their livelihoods and the national economy (Njombe, 2010).

In an effort to address farmers issues on improved dairy husbandry practices constraints to dairy farmers in Tanzania, the Livestock Training Institute (LITI) - Tengeru started farmers training programmes in 1983 being supported by various NGOs such as Heifer Project International (HPI), World Vision Tanzania (WVT), Hans Seidel Foundation (HSS) and Tanganyika Farmers Association (TFA) that worked towards alleviating poverty among smallholder dairy farmers in Tanzania. Additionally, the various organizations provided support on promoting sustainable Agriculture by facilitating pass on schemes on livestock especially dairy animals (heifers and doe) and covering training costs of farmers in integrated dairy husbandry courses to smallscale dairy farmers (Kinsey ,2008).

Dairy farmers were trained in improved dairy husbandry practices mainly on proper feed and feeding, establishing of improved pastures and fodder trees, dairy farm record keeping, proper hand milking, construction and use of improved dairy house/structure, disease control, Selection and breeding of dairy animals. To date 5 782 dairy farmers in the country have formally attended training on integrated dairy husbandry at LITI-Tengeru (Kapinga, 2011). Out of these 243 are from Arumeru district. Despite these trainings, the extent to which the trained dairy farmers have adopted and are applying the practices they learned is not well established.

Earlier studies on adoption such as Mugisha *et al.* (2012) have only indicated whether the recommended package of improved practices has been adopted or not by farmers. This gives percentages of farmers adopting the practices, not the percentages of improved practices adopted by farmers and the constraints encountered by them in effectively practicing the taught improved skills, results of such studies were therefore generalized. though more information was required to ascertain if what farmers were trained on improved dairy husbandry practices were put into practice and have yielded a measurable change in their activities and performance in dairy rearing, this study investigated the extent to which trained dairy farmers practice competently the knowledge and skills they were taught.

1.2 Problem Statement and Justification of the Study

Adoption of dairy improved husbandry practices involves a process in which awareness is created, attitudes are changing and favourable conditions for actual use of recommended practices are provided to the dairy farmers (Lemma and Trivedi, 2012). To enhance the production potential of dairy animals several interventions have been institutionalized to salvage the industry performance so that it can meaningfully contribute to the socioeconomic development of smallholder farmers and the country as well.

Dairy development strategy at the smallholder level requires some change in knowledge and management skills, which calls for training on improved dairy husbandry practices. It has been a usual trend, such that little is done to follow up and trace back if trained farmers do put in practice the skills they learned, even to establish the extent to which improved dairy husbandry skills are practiced by farmers and constraints which trained dairy farmers do face leading to them failing to exercise what they learnt.

Farmers' training programmes may operate with an assumption that farmers will put into practice the improved practices they were taught while in reality there might be other factors limiting them. It is important to follow the degree by which the ultimate beneficiaries are actually changing and depicting any problems that have occurred so that measures and or modifications could be advanced to ensure increased use of improved practices (Quddus, 2012). This study therefore, focused to assess as to whether the training of farmers on improved dairy husbandry practices had brought changes to the targeted farmers on adopting the improved dairy husbandry practices. Additionally the study also investigated on factors influencing trained dairy farmers to practice what they were taught at LITI-Tengeru.

The findings from this study form a basis and add knowledge to various stakeholders of the sub-sector in assessing the influence of farmers' training in enhancing adoption of the improved dairy husbandry practices to trained farmers, but also form a basis of noticeable and measurable behavior changed in the activity performance using knowledge and skills gained by trained farmers when back in their roles.

1.3 Objectives of the Study

1.3.1 Main objective of the study

The main objective of the study was to assess the influence of farmers' training on enhancing adoption of the improved dairy husbandry practices among trained farmers.

1.3.2 Specific objectives

The specific objectives of the study were to;

1) Identify improved dairy husbandry practices taught to small scale dairy' farmers.

2) Determine the extent to which taught improved dairy husbandry skills are practiced by farmers.
3) Determine socioeconomic factors influencing trained farmers to effectively practice improved dairy husbandry skills they learned.

1.3.3 Research questions

1) Which improved dairy husbandry practices were taught to dairy farmers?
2) To what extent are the taught improved dairy husbandry practices being applied by trained dairy farmers?
3) What are the socioeconomic factors influencing trained farmers to practice improved dairy husbandry practices?
4) What suggestions could be put forward to enhance adoption and use of improved dairy husbandry practices by trained farmers?

1.4 The Conceptual Framework

Based on the literature review, adoption of given technologies is hypothesized to be influenced by socio-demographic attributes such as age, sex , level of education, family size, and socioeconomic factors like income, land size, off-dairy income, institutional factors like access to credit, study tour and extension contact and improved dairy husbandry practices characteristics like its relevance, compatibility, simplicity, costs). As noted by Degnet and Belay (2001) the reasons for adoption or non-adoption at farm level vary over various reasons. A total effect of the socio-demographic and other factors may in one way or the other influence a trained farmer to adopt and continue practicing the skills one learned. The total effect imposed by the different factors on an individual might enhance or retard the level at which a trained farmer will use the practices (See Fig.1).

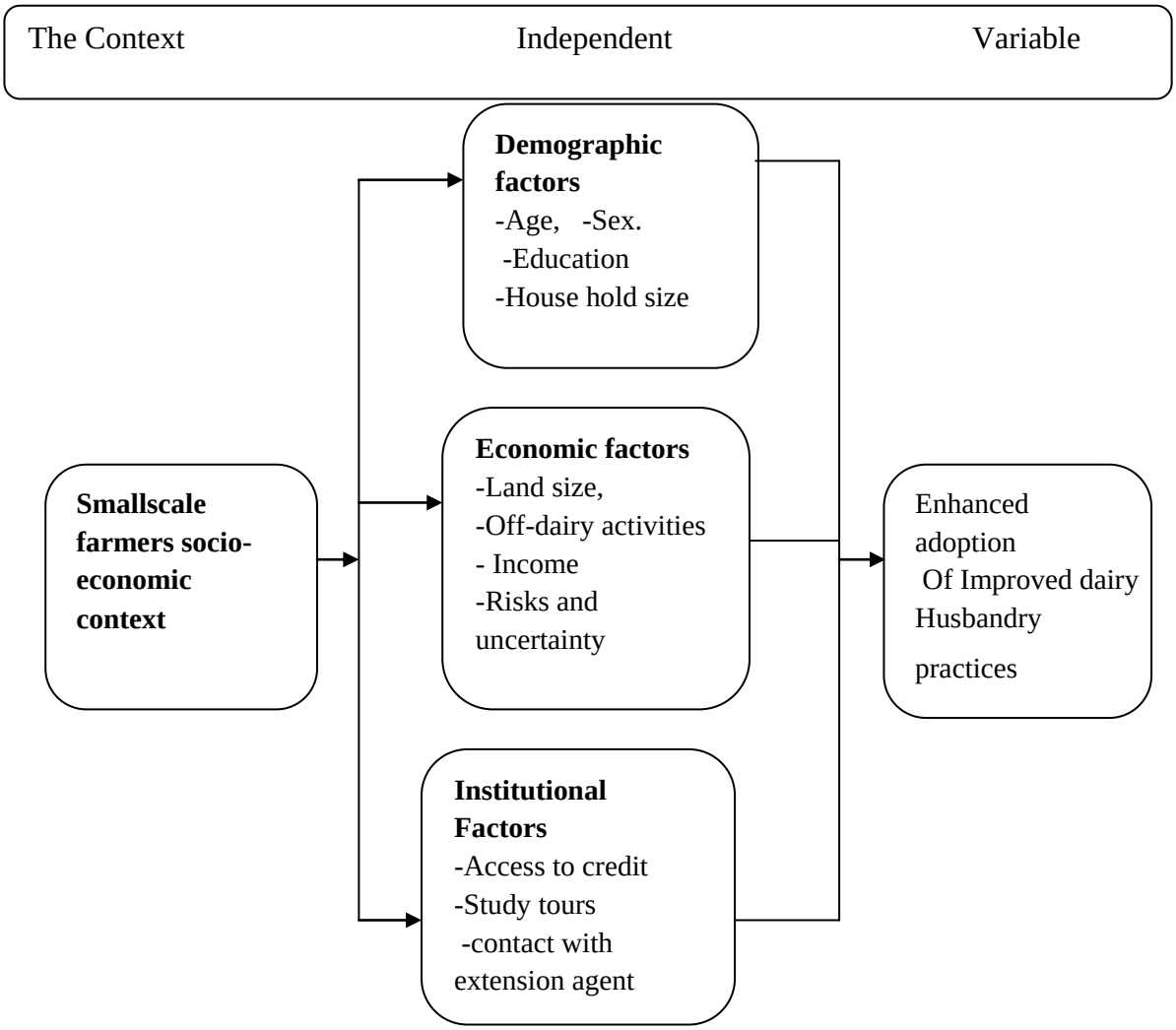

Figure 1: Conceptual Framework on adoption of improved dairy husbandry practices

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Development of Dairy Farming in Tanzania

Dairy farming in Tanzania has been growing at a rate of 6% per year and currently there are about 190 000 registered dairy farmers (Swai and Kurimuribo, 2011). Most of the large-scale dairy farming is practiced in the highlands and relatively cool regions of Arusha, Mbeya, Kagera, Iringa and Morogoro. However, small-scale dairy farming is currently a common feature in all parts of the country and in cities. The dairy sub- sector has great potential to contribute to economic development in Tanzania.

Livestock industry accounts for 3.8% of the Gross Domestic Product (GDP), with the dairy sub-sector contributing 30% of this output (Njombe, 2010). However, the dairy sub-sector contribution is not only limited to its share to total GDP but also play other important role such as improving food security and welfare, creating employment and also, Milk and milk products production generates reliable income to meet household livelihoods (Somda *et al.,* 2005). Other benefits of dairy production include the supply of nutritious, affordable and valuable food products for the local population; and opportunities for long-term expansion in domestic and regional export markets.

Based on the importance of the dairy sector in Tanzania, creating an enabling environment that small dairy farmers could use improved dairy husbandry practices effectively to enhance its production performance and competitiveness is highly desirable. In view of this, the National Strategy for Growth and Reduction of Poverty (NSGRP), recognizes the dairy sub- sector as one of the key vehicles for poverty reduction and thus advocates its development. The National Livestock Policy is also

geared toward encouraging the development of a commercially oriented, efficient and improved competitive dairy industry. The role of the Government according to this policy is to accelerate the reform process and continue maintaining a favourable macroeconomic policy environment that is conducive for multi- stakeholders' participation in the livestock industry.

The move to enhance competitiveness of the dairy industry is also in line with Agricultural Sector Development Programme (ASDP) that aims at creating an enabling and conducive environment for improving the productivity and profitability of the livestock sector through its dairy industry sub-sector. Therefore, contribution of livestock sector to the national economy cannot be overemphasized. To make the sector vibrant, development of the dairy industry sub-sector is imperative for it to contribute effectively to the national economy and farmer's livelihood. Dairy farming is a highly skilled enterprise, which needs the use of improved dairy husbandry practices and competent committed farmers.

2.2 Farmers' Training in Tanzania

Farmers' training is a process of imparting specific practical skills to farmers that let them better perform their farm production activities and become more competent and proficient in doing their farm work (Imaita, 2013). According to Khan *et al.* (2009) many studies have demonstrated the high economic return to investment in improved husbandry practices through extension and training despite the difficulty of isolating its impact on agricultural productivity and growth from other factors. Investment in developing improved and disseminating practices suitable for farmers is thus crucial for livestock sector growth.

In a developing country like Tanzania, dairy farming is one of the major agricultural activities in the country that is contributing towards achieving development goals of the National Growth and Reduction of Poverty (URT, 2010). Therefore, in view of the importance of the Dairy industry sub-sector to the Tanzanian economy and to the people's livelihoods, focusing on improving viable improved dairy husbandry practices for small holder dairy as a matter of priority will encourage the adoption of new technologies and help to raise farm profitability. Farmer training is not a new phenomenon in developing countries. In Tanzania, farmers training existed before the colonial era. Farmer had their own informal way of sharing agricultural knowledge and skills. During the colonial era, the colonial administrators were responsible for providing extension services. According to Rogers (2003), extension education falls into the category of informal education at the grassroots level, several farmers training centres were aimed at training farmers in various disciplines related to agriculture, according to locality. Farmers training centres performed well up to 1972, when they were transferred to the Prime Minister's office and subsequently to the Ministry of Education. In order to realize the importance of training, the Government of Tanzania took cognizance of the need to train farmers.

It re-established Farmers Training centers (FTCs) where farmers could attend short training courses in agriculture and livestock production. The emphasis was on practical application rather than on theoretical training, in which an experimental learning situations was adopted that requires horizontal sharing of ideas and active participation of the farmer based on the field experiences (Nzully, 2007). With United States of Agency for International Development (USAID) assistance late 1980, the Government of Tanzania established five farmers training institutes on pilot basis. Later all six Livestock Training Institutes (LITIs) namely Mpwapwa, Morogoro, Tengeru, Madaba, Temeke and

Buhuri established their own farmers training wings that offered vocational training to farmers in order to improve their knowledge, skills and receptivity to new technology. Therefore, farmers' training has continued to be the most important device for developing and updating farmers on improved husbandry practices.

2.3 Factors Influencing Farmers to Adopt Improved Dairy Husbandry Practices

Adoption of innovations refers to the decision to apply an improved practice and to continue to use it (Rogers, 2003). This is closely followed by the main options of active rejection, which occurs when farmers consider adoption of innovation (including its trial) but then deciding not to adopt it and passive rejection (also called non-adoption), which consists of never really considering the use of the improved practice. The concept of sustainable adoption was defined as the degree to which an innovation continues to be used over time after a diffusion programme ends, such as Farmers Training (Rogers 2003). This is closely related to the term continued adoption which is the persistent use of an improved practice. Tsegaye *et al.* (2008) analysed sustained adoption among farmers and the concept was operationalised as the maintenance of the intensity of adoption by farmers.

Dadi *et al*. (2004) used duration analysis to capture the dynamic aspects of adoption of agricultural technologies by explaining the probability of adoption rather than the time it takes an individual to adopt. Wetengere (2010) reported that the concept of selective adoption exists among farmers and it was described as the selection of some parts of a technology or modification Farmers' choice whether to adopt an entire package of a recommended improved dairy husbandry practice or just some parts of it influenced by availability of household resources; the degree to which the practice is appropriate for the

farmer's, farming environment; farmers' characteristics and farmers' objective for undertaking the activity (particularly spread risk).

Khan *et al.* (2006) indicated that adoption gap is the difference between potential and actual adoption rate, which can be reduced through an effective dissemination and continuously follow up by extension officers. The rate of adoption is defined as the percentage of farmers who have adopted a given technology (Negash, 2007). Arega (2009) reported that the extent of adoption refers to the number of technologies practiced, also tested as the percentage of each practice by the same farmer. The intensity of adoption of different technologies is measured by a variable that represents the breadth of technology use within a particular stage of production. IFAD (2010) determined the intensity of adoption as the amount of modern inputs used per unit area, while Tsegaye *et al.* (2008) measured the intensity of adoption in the order of the number of the components of the technology adopted by a farmer.

There are a number of factors influencing adoption and its patterns of diffusion of livestock technologies. According to Bwisa *et al.* (1997), adoption is classified into individual and aggregate adoption according to its coverage. They define individual adoption as is referred to farmer’s decision to use improved practices into production process when the farmer has full information, knowledgeable and practical skill about the specific improved practice. They make a distinction between this and aggregate adoption which is a process of spread or diffusion of improved practices within a region a population. The study of the adoption of improved dairy husbandry practices is referred to individual farmer adoption. The adoption pattern to a technological change in dairy husbandry is not uniform at the farm.

The researcher defined individual adoption to mean trained dairy farmer's decision to use the taught improved dairy husbandry practices into production process when the farmer has full information, knowledge and practical skills. The rapid widespread and massive adoption of improved dairy husbandry were strongly linked to several factors; These explanatory indicators vary from study to study based on their contextual applicability, but traditionally include: 1) human capital 2) farm size 3), risk exposure and capacity to bear risk, 4) labour availability, 5) credit constraints and 6) access to extension services.

In delineating these particular factors, they point out that the categories are not discrete or exclusive and that boundaries may blur and overlap due to the interdependent relationship between indicator. For example, inadequate rural financial systems decrease the availability of affordable credit; a lack of credit increases aversion to risky undertakings such as new technology adoption; higher levels of risk aversion or decreased ability to mitigate and bear risk are correlated with higher levels adoption. Many studies have shown that each of these indicators significantly influences the agricultural technology adoption process (Salim, 1986).

The factors that are important in influencing the adoption of improved dairy husbandry practices include:

2.3.1 Socio- demographic characteristics

Human Capital is the quality of labour available or ability to command labour for adoption of improved husbandry practices. These variables are comprised of individual or community characteristics such as age, education, sex, household size, and their relationship to technology adoption is one of potential.

Age is said to be a primary latent characteristic in adoption decisions. However there is a contention on the direction of the effect of age on adoption. Young and energetic farmers have proved to be active and ready to try new innovations (Nanai, 1993). On the study of Land based enterprise by Singh (2011) found that technology adoption was not significant influenced by young ranging from 25 to 40 years. Amir and Pannel (1999) stated that older farmers have more experience, resources and authority that would give them more possibilities for trying new innovations. However, Dogbe (2006) argued that though older people have experience and resources, their receptivity to new ideas and technologies typically decreases with age. Due to the inconsistency of findings between age and adoption, Nkonya and Norman (2003) concluded that the effect of age on adoption tended to be location and technology specific. Age can generate or erode confidence in new technology; Also, Bulale (2000) found age as inversely related to adoption of dairy technology.

Farmers' educational background is a potential factor in determining the readiness to accept and properly use of an innovation (Amir, 2006). The relationship between farmers education and attitude towards improved dairy husbandry is an empirical question as it provides the dairy farmer with necessary skills to enhance adoption of improved dairy husbandry practices. Improved dairy husbandry practices involve technical applicability and a dairy farmer with high level of education has a better chance to acquire more information about potential innovations, and make rational evaluations of the risks involved in trying the improved practice which comprehends to the taught aspects (Akinbile, 2003). The outcome of the taught improved husbandry practices to a dairy farmer is viewed on its adoption and putting them into practice.

Crook (2011) breaks down human capital into worker ability and allocative ability, with the latter defined as the ability to adjust to change. It is suggested that farmers with higher education possess have higher allocative abilities and are able to adjust faster to farm and technologies adoption conditions. Crook *et al.* (2011) when studying a Meta analysis relationship between human capital and firm performance found that human capital is positively correlated with innovators or early adopters. That is, farmers with higher levels of education adopt new technologies more rapidly than farmers with lower education; and laggards are associated both with lower education.

Sex is one of the most important factors influencing adoption of improved husbandry practices. The utilization of improved practices in developing human and material resources can be considerably enhanced when females are included since they are responsible for 50-60% of dairy production and most domestic tasks (Doss and Moris, 2001). In most African social contexts, women have limited access to resources, especially land and to information.

The involvement of women in the dairy industry in developing countries is widely acknowledged, Kimaro *et al.* (2013) while studying the influence of women's group on income obtained from small scale dairy cattle production in Arumeru, Tanzania contended that because women play a key role in most of the agricultural systems, particularly in the dairy husbandry practices such as milking, feeding, de-worming, record keeping. It is important that adoption studies consider the degree to which improved dairy husbandry practices reaches female farmers, it is to be facilitated by equal participation of female farmers in the training.

All land management improved practices requires labour input from households, they are intended to make better use of resources such as labour and initial adoption will mostly likely entail greater labour from the household. Kimaro *et al.* (2013) observed that a family with larger number of members is more likely to try and continue using a potential profitable technology.

2.3.2 Socioeconomic characteristics

The socio-economic characteristics of the sampled respondents are income, land, off-dairy income generating activities influence adoption of improved practices in both directions. Farmers with higher income are more likely to be adopters of new practices than farmers with low income. This is mainly due to the fact that level of income dictates the level of expenditure, since most of dairy improved dairy husbandry practices are money demanding such as costs for concentrates, buying veterinary drugs, then a dairy farmer with high level of income is likely to adopt the improved dairy husbandry practices compared to those with less income (Mujuni *et al.,* 2012). High income also has a positive influence on the initial stages of trial of innovations as wealth allows the farmers to invest a relatively small proportion of their income to venture into an uncertain enterprise (Amir and Pannel, 1999). Shivley (1999) found that high income was positively correlated with adoption of hedgerows in the Philippines.

Moreover, lack of initial capital among smallholder farmers contributes enormously to rejection of innovations, for well paying innovations such as keeping of an F1 dairy cattle requires that initially a smallholder farmer to spend extra money to buy the animal and the input, which is relatively impossible to smallholder farmer (Mlozi, 2010). However, availability of off-farm income found to have a positive and significant influence the

adoption decision of the farmers on crossbred dairy cows in the central highlands of Ethiopia (Berhan, 2002).

In agricultural related venture, the notion that technological innovations are perceived to be more risky than traditional practices has received considerable support in the literature. Many researchers argue that the perception of increased risk inhibits adoption (Feder *et al.,* 1985). When an innovation first appears potential users are generally uncertain of its effectiveness and tend to view its use as experiment show that uncertainty declines with learning and experience thus induce more risk-averse farmers to adopt an innovation, provided it is profitable (Schaffnit-chatterjee, 2010). Innovators and early adopters are believed to be more inclined to take risk than are "early" and "late majority farmers". Late adopters and Laggards are likely to be even more risk averse.

Moreover, all technology adoption decisions carry with them some mixture of subjective risk such as human tendencies to assume more uncertainty in outcomes from unfamiliar techniques and objective risks resulting from variations in climate, diseases, and the timely access to critical inputs. The observed patterns of technology adoption are typically influenced by the farmers' individual risk preferences and their ability to bear the risk of a new and uncertain endeavor.

Use of improved dairy husbandry practices such as construction of improved dairy animal structures, establishment of improved pasture and fodder plots inevitably requires resources, among other things, land is paramount (Mwajombe,2000). The way land is distributed and owned in a society has always been a problem in many developing countries. Kimaro *et al.* (2013) argue that security of tenure is usually a necessary but not a sufficient condition for poor farmers to invest in improved dairy husbandry practices.

The case is more apparent in Arumeru District where a land is problem. Tenure incorporates issues addressed on credit constraints and risk and uncertainty. As mentioned above, the uncertainty associated with a change of course is an impediment to technology adoption. It is the most vulnerable communities, those that are least able to afford a decrease in output, that are the most risk-averse.

The most vulnerable communities are also more likely to have insecure tenure rights. The self-reinforcing nature of vulnerability means that those who can least afford to take on risk are the ones who are trapped in a cycle of poverty due to that risk-aversion. Poverty status is also related to land insecurity, further reducing these communities' incentives to adopt risky technology, and further promoting the risk-poverty-tenure cycle.

Farm size is among of the factors measured when modelling adoption processes. Land as a factor of production and storage of wealth is the most important asset influencing adoption (Shively, 1999). Farm size does not always have the same effect on adoption; rather, the effects of farm size vary depending on the typology, characteristics of technology being introduced, and the institutional setting of the local community.

The relationship between farm size and adoption depends on factors such as fixed adoption costs, risk preferences, human capital, credit constraints, labour requirement and tenure arrangements (Feder *et al.,* 1985). Fixed costs are often a primary barrier to adoption; therefore, spreading fixed costs over a larger farm may be one explanation for the observed positive association between farm size and propensity to adopt. Mapiye *et al.* (2006) identified land shortage as one of the major factors affecting adoption of forage/browse legumes in Nharira-Lancashire, Zimbambwe. This can be attributed to the fact that forage/browse legume production competes with food crop production and

farmers may not want to take land away from food production for other uses. Accordingly, forage/browse legumes compete with crop residues, which can be grazed at low labour input (Mwangi, 1995).

Farmers with larger farms are more likely to adopt new technologies because they can spread the costs over a wide range of outputs than it is possible for small-scale farmers. Nzully (2007) found that farmers with large farms were able to adopt rain water harvesting technologies in their farms than those with small farms. This was possible because farmers were able to take risks of experiment with the new technology. Use of one of the intercropping techniques or using fallow areas would not affect the cereal crops. On the other hand intensification of agriculture related activities, such as use of modern soil fertility management techniques, encourages adoption. This implies that the development and use by farmers of high yielding crop varieties and intensive crop management practices can significantly enhance adoption of forage/browse legumes by releasing land for forage production (Gebremedhin *et al* ., 2003). Therefore, farm size may act as a proxy for any trained dairy farmer on adoption of establishing improved pasture and fodder trees, and also construction of an improved dairy house/structure practices.

With larger farms are more likely to adopt improved dairy husbandry practices because they can spread the costs over a wide range of outputs than it is possible for small farms. Mugisha *et al.* (2012) found a significant relationship between farm size and the adoption of high yielding enterprises and use of improved varieties or breeds. Small farms typically rely on a single parcel of the land to meet food requirements while farmers with larger farms may utilize other parcel in various activities like for pasture production, land for animal structure.

2.3.3 Institutional factors

These are derived from privately or publicly operated systems for providing services to the dairy farmers. These include credit and marketing facilities, research, training and extension services (Machumu, 1995). Rejection or acceptance of an improved practice largely depend on the felt needs of the farmer they serve and how the information or skill is relayed from the source mainly from the institutions. The slow rate of adoption is frequently an indictment of project methodology used rather than unwillingness of farmers to adopt the improved practice (Lionberger and Gwin, 1991).

Access to credit is an indicator which manifests itself in other factors, such as farm size (since a farmer can borrow more money against a larger farm than a smaller farm, all other things being equal), human capital (because farmers with more education are better informed about credit facilities and can even shop around for competitive interest rates), and tenure (since a sharecropper does not own land, and cannot borrow against its value). It is obviously that increased access to credit sources can help farmers surmount short-run liquidity constraints and increase technology adoption. Any fixed investment requires the use of own or borrowed capital. Hence, the adoption of a non-divisible technology, which requires a large initial investment, may be hampered by lack of borrowing capacity (El-osta and Morehart, 1999). Lee *et al.* (2006) noted that increased access to credit sources can help farmers overcome short-run liquidity constraints and increase technology adoption. Dairy husbandry is carried out by smallholder farmers who in most cases are resource poor. In this situation they will tend to avoid risk associated with credits which could otherwise improve their investment and manage to use effectively the improved practices and later produce more. Meena (2012) Commented that perpetual low marginal and inability to qualify for credit by lending institutions lead to smallholder farmers into cyclic problem of lack of capital for investment in improved practices. Improved dairy

husbandry practices, clearly fits the model of a capital intensive technology especially if training and education costs are considered. Consequently a credit or capital constraint could retard improved practices adoption.

Feder *et al.* (1985) noted that extension efforts increased the adoption probability of new technology by increasing the stock of information pertaining to modern production increment. The major role of extension in many countries in the past was seen to be mainly transfer of new technologies. Now it is seen more as a process of helping farmers to make their own decisions by increasing the range of options from which they can choose, and helping them to develop insight into consequences of each option (Amandeep and Bhatti, 2006). As noted by (Hagmann *et al.,* 2003). The role of extension may include building the capacity of farmers and farmer's organization to pursue their development goals, this can be influenced by close follow up which enable them to examine their farming situations. This in turn, develops farmers' aspiration for change through adopting farm technologies. Also, linking farmers and farmers' organization to other support agencies including credit facilities, market and input systems creating platform for their interaction and facilitating negotiations between the different stakeholders. Generally, extension plays a great role in popularizing improved dairy husbandry practices to farmers.

A study by Makokha *et al.* (1999) found that farmers' participation in agricultural exhibition, field days and demonstration have significant influence on perception and hence adoption decisions of farmers. Study tour to different areas with related production activities increases the farmers' insight and appreciation of learned technologies by seeing to be possible practiced by others. Location factor such as soil fertility, climate and availability or access to information like market and inputs, can influence the

adoption of different technologies across different farm or location of production enterprise. Heterogeneity of resource base has shown to influence technology adoption and profitability. However, Batz *et al*. (1999) and Kaliba *et al*. (1997) have underscored the need of considering the improved practice characteristics influencing adoption in a situation where the sample is relatively homogeneous with respect to farmers characteristics and if the farmers are also working under comparable farming circumstances.

2.4 Farmers' Adoption Decision

Adoption of improved practices by a farmer is necessarily based on his capacity to acquire and absorb information about new techniques and on his /her capacity to convert this knowledge into practice (Abebe, 2007). Adoption is a decision –making process in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. The decision making is the process through which an individual passes knowledge of an innovation, to forming an attitude towards innovation, to a decision to adopt or reject, implementation of new ideas, and confirmation of decision (Rogers, 2003). Ehui *et al.* (2004) noted that an improved husbandry practice that introduces to smallholder farmers by itself does not guarantee its wide spread adoption and efficient use. For efficient utilization of the improved dairy husbandry practice, the fulfilment of specific socio-economic, technical and institutional conditions are required.

From the farmers' perspective the improved practice should be economically more profitable than the existing alternatives. Also should be technically easily manageable by smallholder and adapted to the surrounding socio-cultural situations. Similarly, the availability of the improved practices and all other necessary inputs to smallholders at the right time and place and in the right quantity and quality should be ensured.

According to adoption perceived attribute theory by Rogers, (1995) an innovation is judged for adoption by a farmer: when it can be tried out (trialability), that results can be observed (observability), that it has an advantage over other innovations or the present circumstance (relative advantage), that it is not overly complex to learn or use (complexity), that it fits in or is compatible with the circumstances into which it will be adopted (compatibility). Therefore, introducing improved dairy husbandry practice with those attributes can be adopted at higher level by trained dairy farmers.

2.5 Improved Dairy Husbandry Practice Characteristics

Good livestock practices for dairy farmers entails implementing sound practices on dairy farms collectively. These practices must ensure that milk and milk products are safe and suitable for their intended use, and also the dairy farm enterprise is viable from the economic, social and environment perspectives, it includes animal health status and preventive measures, proper hand milking and hygiene, feeds and feeding, improved dairy housing and establishment pasture and fodder tree (FAO, 2011). As given, improved husbandry practices embody a number of important characteristics that may influence adoption decision. The observed adoption choice on agricultural technology is hypothesized to be the end result of a complex set of inter technology preference comparison made by the farmers (Adesina and Baidu-Forson, 1995). Farmers therefore make decision to adopt technology if the utility exceeds utility of the old one.

The central objective of farmers training is to help farmers to acquire knowledge and skills along those lines of their current interests and needs which are closely related to increasing farm production and improving the physical level of living (Halakatti *et al.,* 2007). Farmers must perceive a need for the new technology in order to adopt many

innovations from research and training institutions are not accepted because they not demand driven (Arega, 2009).

Initial cost refers to the initial cost of buying the smallest unit of the technology. Initial costs determine the decision to adopt a technology especially to resource poor smallholder farmers. This means that, if the farmers are resource poor and access to capital is limited, profitable technologies might not be adopted if they require a big capital outlay (Batz *et al.*, 1999).

Improved practice compatible with existing farmers conditions are most likely to be adopted quickly (Bwisa and Gacuhi, 1997). These include farmers' economic, technical and social status. Improved technology and capabilities' of farmer is a necessary condition for improved dairy husbandry practice since small holder dairy farmer can only adopt improved practice if it is within his/her means.

An easy to demonstrate and implement practice is more quickly adopted (FAO, 2011). Simplicity means that a greater number of farmers regardless of their educational background would be able to understand the method and its advantages and forecast the benefits.

Some technology may be assumed to have high risk reduction effect in a high risk environment where as other technologies may have no effect or even increase it. Technologies with a high risk reducing effect will be adopted faster than low risk reduction technologies Risk avoidance is a characteristic pattern in the survival strategies of small farmers and many dairy farmers may base their decisions more ethical and social motives rather than on economic considerations (Somers,1991). However, one of the key constraints identified for not adopting improved technologies was non- availability of

cash (Bindlish and Evenson, 1993). In kiambu district in Kenya, for instance, Napier grass was left to overgrow although there was a general shortage of forage (Mwangi, 1995). According to the farmer, Napier grass was left as security against the times of shortage.

During rainy seasons when there was plenty , farmers purchased fodder-off farm since the price was low rather go into fodder conservation, which involved expenditure on materials and labour. This indicates that improved dairy husbandry practice that cost little to implement are likely to be adopted quicker than those requiring large expenditure (FAO, 2011).

Changes in production systems due to external factors could necessitate adoption of certain improved practice. In Arumeru, where there was a rapid move towards zero grazing high yielding fodder crops such as napier grass and other farm by-products inevitably became more popular due to high demand for roughages (Morton, 1995) . In this case, adoption of zero grazing and napier grass production was caused by external factors namely land and population pressure. Therefore, technologies selected by researchers for propagations should have been carefully tested and considered in terms of their perceived attributes from the farmers' point of view, differences in perceptions between researchers and farmers could help differences in adoption rate expected by scientists and that observed in the field condition (Singh *et al.,* 2011).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

This study was carried out in Arumeru district in Arusha Region. The area was chosen purposively because LITI-Tengeru started farmers' training programme to surrounding farmers since 1983. Also, Arumeru district council was selected because of its vibrant and increase in dairy animal keeping. Arumeru district is one among the six district of Arusha Region. The council covers an area of 1.28 km^2 with a population estimate of 225.17 (2002 National Census). The district is located in the North Eastern part of the Arusha Region. It boarders Siha District in Kilimanjaro Region to the east, Simanjiro District in Manyara Region to the south and Arusha District Council to the west. It lies between longitude $3^o15 – 3^o55'$ E and Latitude $3^o00 – 3^o40'$ South of Equator on the wind ward side of Mount Meru.

Administratively the district is divided into 3 divisions with a total of 17 wards and 71 villages. The district receives an annual rainfall range between 500 mm – 1 200 mm. The district has the bimodal type of rainfall; short rains which fall from November to January and long rains which normally fall from March to June. The average temperatures ranges from 25^0C to 15^0C for January – February and June – August, respectively.

According to population and housing Census conducted in 2012, Arumeru district had a population of 268 144 in which 136 880 are female and 131 264 are male. The District council has 4 878 households with an average size of 4.3 members. The population growth rate is 3.1% per annum which is well above that of Arusha Region and National which is 2.9%. However, two thirds of the district population live in rural areas.

Livestock kept include cattle, goat, sheep, pigs, donkey and chickens. On high altitude, there are agro pastoralists and mostly practice Zero grazing system while on middle and lowlands are pastoralists. According to DADPs, 2012/2013, the livestock populations in the Arumeru district include indigenous cattle (14 515), dairy cattle (90 281) and dairy goats (3 871).

3.2 Research Design

A research design is an assemblage of conditions for: specifying relationships among variables in a study, operationalizing these variables, and controlling effects of extraneous variables; and a plan for selecting the sources and types of information to be used in answering the research questions (Ndunguru, 2007). The study adopted a cross-sectional design approach. According to Adam and Kamuzora, (2008) the design allows data to be collected at a single point in time to capture important aspects for the trained dairy farmers on improved dairy husbandry practices they learned. Data on the improved dairy husbandry practices were collected from sampled trained dairy farmers to ascertain the improved practices they were taught. The score by a farmer on each improved dairy husbandry practice were also collected to determine the extent and level of adoption by sampled trained dairy farmers. Moreover, the design had a broad scope of incorporating numerous different variables at once.

3.3 Sampling Frame and Sampling Procedure

3.3.1 Sampling frame

The sampling frame included all farmers keeping dairy animals (cattle and goats) and who were trained on dairy husbandry courses at Livestock Training institute - Tengeru, constituted the study population totalled to 243. Dairy cattle and goats were selected because they are commonly kept in the study area.

3.3.2 Sample size determination

The study elicited information from trained dairy farmers under study. To obtain the desired sample, a simplified formula for the proportions by Yamane (1973) was adopted. The formula was adopted assuming a 95% of confidence level and precision of 0.05. A resulting sample size was:

$n = N/1+N (e^2)$…….. (1)

Where n is the sample size,

N is the population size = 243

e is the level of precision (sampling error) = 5%

When this formula was applied to 243 populations of the trained dairy farmers in the study area, it gives,

n = 243/ (1+243*(0.05^2),

Sample size (n) = 151.173

At household level, the trained dairy farmers were targeted because it was expected that these would provide information on improved dairy husbandry practices they learned.

3.3.3 Sampling procedure

Since the sampled population was heterogeneous with respect to characteristics and years of training that were studied. A stratified random sampling technique was used to reduce

sample heterogeneity, by grouping the study population into five strata based on years during which the dairy farmers attended the course; these were 1983-1990, 1991-1995, 1996-2000, 2001-2005 and 2006-2010. Using a formula below (2) each sub-population (strata) was used to calculate the required sub-sample from each stratum which contributed proportionately to the total sample size (Ndunguru, 2007).

$$n_i = \left[\frac{Ni}{N}\right] n \quad \text{.....(2)}$$

Where: n=sample size studied, N=size of population studied, Ni=size of the i^{th} of sub-population (strata).

From a list of trained dairy farmers within each stratum, a desired sample of 150 respondents was picked proportionately using a table of random numbers.

Total Sample size(n=150) from a study population of (N=243)

Study population		Strata									
		1983-1990		1991-1995		1996-2000		2001-2005		2006-2010	
N	%	N	%	N	%	N	%	N	%	N	%
243	100	35	15	46	19	32	13	69	28	61	25

Sample size		1983-1990		1991-1995		1996-2000		2001-2005		2006-2010	
N	%	n	%	n	%	n	%	N	%	N	%
150	100	22	15	28	19	20	13	42	28	38	25

Figure 2: **The distribution of the sample size according to size of sub-population.**

Considering the total budget, relocation from the village and distance between the trained dairy farmers to be studied, a total of 140 trained dairy farmers were interviewed equal to 93.33% of the expected sample.

3.3.4 Pretesting

The interview schedule was pretested at the farm level on randomly selected trained dairy farmers. For the purpose of addressing the amount of systemic or "in-built" error, the interview schedule developed was tested to a sample of 10 trained dairy farmers who were not included in the study sample in Kikwe ward to gain their reactions to the questions and determine tool content validity. The content validity was intended to see if the ordering, wording of questions and coverage of the interview schedule was understood equally to different classes of respondents, whether the questions as they are worded could achieve the intended results and see if the questions were arranged in the best order. Also, pre testing was carried out to eliminate unwanted questions and adding new questions needed, and be equally understood by enumerators. The corrected version was used for data collection.

3.4 Data Collection

Data collection is the process of gathering and measuring information on variables interested, in an established systematic fashion that enables one to answer stated research questions, test hypotheses and evaluate outcomes (Dodge, 2003). For this study both primary and secondary data were collected. For the purpose of addressing the study objectives, both qualitative and quantitative data were collected.

3.4.1 Primary data

Primary data are the data observed or collected directly from first- hand experience (Dodge, 2003). Interview schedule was designed to elicit answers from respondents,

structured interview schedule used to cover the socio demographic and economic information of the household, animal husbandry practices and the factors influencing the farmers to effective practicing the improved skills. Supplemental facts were gathered through using observational checklist to verify the ideal steps used for proper hand milking and hygiene, main parts of an improved dairy house/structure, the presence of record keeping card, feeding and feeds, established pasture plots, health status of the animals and other dairy husbandry practices, and through Focus Group Discussions (FGDs), key informants (Progressive dairy farmers, Livestock extension agents and other officials from District Council).

3.4.2 Secondary data

Secondary data are the data that were collected by someone else or for a purpose other than the current one (Dodge, 2003). The secondary data were collected from LITI Tengeru Library. Information collected included types of training, duration, improved dairy husbandry practices taught, number of farmers attended dairy husbandry trainings, location of these farmers and the general course content. Other sources of information were collected from Sokoine National Agricultural Library (SNAL), Arumeru District Agricultural Department, text books, journals, and reports (published and unpublished) were accessed.

3.5 Data Analysis

Data analysis is the process of evaluating data using analytical and logical reasoning to examine each component of the data provided (Dodge, 2003). For this study, descriptive and regression were used to analyse collected data. Data from the primary source were verified, coded and entered in a Statistical Package for Social Science (SPSS) software, descriptive and inferential statistics were employed to analyze data.

3.5.1 Study objective 1: Improved dairy husbandry practices

3.5.1.1Descriptive analysis

Descriptive analysis was used whereby qualitative and quantitative data from trained dairy farmers were summarized, coded and entered in the software programme Statistical Package for Social Science (SPSS) version 16 spread sheet for analysis to give the descriptive statistics for quantitative description of information, minimum and maximum, frequencies and percentages were obtained and used to present results.

3.5.2 Study objective 2: Extent to which improved dairy husbandry skills are practiced

Adoption is the outcome of a dynamic decision –making process that make full use of an innovation at best appropriate course of action includes learning about improved husbandry practice through training, collection of information or the experimentation.

For multiple practices like improved dairy husbandry practices, there are mainly two options of measuring the adoption; 1) adoption index : measures the extent of adoption at the time of the survey or 2) adoption quotient; measures the degree or extent of use with reference to the optimum possible without taking time into consideration (Negash, 2007). In this study, the first option was employed. Accordingly, adoption index which shows to what extent the trained dairy farmers have adopted the whole set of improved husbandry practices they learned (Rao *et al.,* 1992, Lemma and Trivedi, 2012). Moreover, extent of adoption refers to the level of use of a given technology in any given time.

This study determined the extent of adoption of seven main improved dairy husbandry practices taught to dairy; Proper hand milking and hygiene, improved dairy house,

selection and breeding, dairy farm records, feeds and feeding, establishment of improved pasture and fodder trees, and Animal health status and preventive measures.

Filled interview schedules were coded and keyed into Statistical Package for Social Sciences (SPSS Version 16) computer software. Data were then analyzed using descriptive statistics to obtain total score of each practice to an individual farmer and the expected maximum score a farmer can score to each practice.

The taught improved dairy husbandry practices were used in calculating the adoption index. The scoring of each practice was done on a scale with two-point continuum (doing the practice and not doing the practice). In this method a score of 1(one) was assigned to every subsequent practice in the main dairy husbandry practice being carried out and 0(zero) for every subsequent practice that was not being carried out by a farmer. There were eight items for proper hand milking and hygiene, eight for improved housing, 24 items for dairy farm records, and 14 items for animal health status. Also, selection and breeding practices had four items to be assessed and observed, three items for pasture and fodder tree establishment practice and 12 for animal feeds and feeding. Thus, every individual respondent was capable of obtaining a score ranging from minimum to maximum score of each improved dairy husbandry practice for its responses. Total score of the individual farmer was arrived at by adding the mean scores obtained on the different practices. These total mean scores were later converted to a standardized mean score of adoption index.

In order to ascertain the extent of adoption of the taught improved dairy husbandry practices adoption index of individual trained farmer was developed with the following formula: Modified from Lemma and Trivedi, 2012 as follows;

$$Adoption\ index\ = \frac{Total\ Adoption\ Score\ obtained\ by\ a\ Farmer}{Expected\ Maximum\ Score\ a\ Farmer\ can\ obtain} X100$$

…….(3)

Then, for the adoption index of whole package of taught improved dairy husbandry practices by a trained dairy farmers were calculated as;

$$Adoption\ index_i = \sum_{j=1,i=1}^{m,n} \left[\frac{breedadoscorej_i}{BREEDADOMAXj} + \frac{fedadoscorej_i}{FEDADOMAXj} + \frac{phmadoscorej_i}{PHMADOMAXj} + \frac{pefadoscorej_i}{PEFADOMAXj} + \frac{ahsadoscorej_i}{AHSADOMAXj} + \frac{rekadoscorej_i}{REKADOMAXj} + \frac{imhadoscorej_i}{IMHADOMAXj}.\right] \div NTIDP$$

……..(4)

Where:

i=1, 2, 3……..n, and n= total number of sampled trained dairy farmers in the study area

j=1, 2, 3……m, and m= total number of items to each taught improved dairy husbandry practices.

breedadoscore = the breeding and selection adoption score of i^{th} farmer

BREEDADOMAXj = the maximum score for breeding and selection practice

fedadoscore = the feeds and feeding adoption score of i^{th} farmer

FEDADOMAXj = the maximum score for feeds and feeding practice

Phmadoscore = the proper hand milking and hygiene adoption score of i^{th} farmer

PHMADOMAXj = the maximum score for proper hand milking and hygiene practice

Pefdoscore	=	the pasture establishment and fodder adoption score of i^{th} farmer
PEFADOMAXj	=	the maximum score for pasture establishment and fodder practice
ahsdoscore	=	the animal health status adoption score of i^{th} farmer
AHSADOMAXj	=	the maximum score for animal health status practice
rekdoscore	=	the record keeping adoption score of i^{th} farmer
REKADOMAXj	=	the maximum score for record keeping practice
imhdoscore	=	improved housing adoption score of i^{th} farmer
IMHADOMAXj	=	the maximum score for improved housing practice
NTIDP	=	Number of taught improved dairy husbandry practices

Further, extent of adoption of improved dairy husbandry practices was analyzed on the basis of Mean percent scores. High adoption score (index) implies high adoption of improved dairy husbandry practices learned by dairy farmers in the study area, Then, overall adoption index obtained by the summation of mean score of individual farmer on the seven improved dairy husbandry practices and finally the overall mean adoption score (index) of taught improved practices obtained from sampled trained dairy farmers in the study area; implies the adoption score which trained dairy farmers practice the improved husbandry effectively after training.

3.5.3 Study objective 3: Factors influencing trained dairy farmers to effectively practice improved dairy husbandry skills

3.5.3.1 Regression analysis

The linear regression model was run to quantify the combined effect of socio-economic factors influencing trained dairy farmers on adoption of improved dairy husbandry practices as predictors as well as to measure the role of each variable in explaining the variation in the dependent variable. The influence of socio-economic variables on farmers' adoption decisions of improved husbandry practices to both positive and negative direction of adoption, mostly have been examined using either the probit/logit model (Kaliba *et al.,* 1997) or the ordinary least squares linear regression model (Mafimisebi *et al.,* 2006; Rahman, 2007; Rezvanfar, 2007; Musaba, 2010).

In this study, the linear regression model was adopted because it involves a continuous dependent variable, while the probit or logit model involves a binary dependent variable. In these models, the dependent variable is specified as a function of farmer socio-economic attributes (like. Age, experience, education level, household size, income, extension contact), and farm attributes (like. farm size, farm type, location). Usually the choice of variables included in these models is not based on any strong theoretical grounds but are guided by past studies and experience. However, for this study, the dependent variable is the adoption index which is expressed as a mean percentage score of practices adopted out of a specific maximum of improved dairy husbandry practices.

The adoption index was taken as a function (variable) of other independent variables(predictors) entailing age of the trained dairy farmer, sex of trained farmer, education level of the trained dairy farmer, household size, off-dairy income generating activities of the trained dairy farmer, family members participating in dairy activities.

Total income of the trained dairy farmer per month, income of the trained dairy farmer from dairy keeping per month, Land spared for dairy keeping by a farmer, credit access for dairy keeping catering for running costs, extension services to trained dairy farmers for training follow up, study tour by trained dairy farmer.

3.5.3.2 Model specifications of the factors influencing the adoption of improved dairy husbandry practices

The level of significance of the variables was tested using a t-test at a 5% and 10% level of significance. A constant ($ß_0$) indicates the extent of adoption of a farmer holding other factors constant. The random error term (μ) was included to account for the other factors other than the tested variables.

The model was specified as follows:

$$Y = ß_0 + ß_1 AGETDF + ß_2 SEXTDF + ß_3 EDUTDF + ß_4 OTHOTDF + ß_5 HHSIZETDF + ß_6 IFDK + ß_7 LDA + ß_8 CRDA + ß_9 SDTDF + ß_{10} EXTSRERB + \mu \quad \ldots\ldots\ldots\ldots \quad (5)$$

Where:

Y = Adoption index (dependent variable)

$ß_0$ = intercept of the regression equation

AGETDF = Age of the trained dairy farmers in years

SEXTDF = Sex of the trained dairy farmer(1 for male, 0 for female)

EDUTDF = Education level expressed as no formal, adult, primary, secondary, tertiary education

OTHOTDF = Off- dairy income generating activities of the trained dairy farmer

HHSIZE = House hold size

IFDK = Income from dairy keeping per month in Tshs

LDA = Land for dairy activities expressed in hectares

CRDA = Credit access for running cost access to credit (1 for access to credit; 0 other wise)

SDTDF = Study tour (1 conducted and 0 not conducted)

EXTSERB = Extension service contact with extension staff for training backup (0 not at all, 1 once every three months, 2 once every month and 3 once every week)

μ = Random error term

Adoption index is expected to change by a certain factor, β (coefficient) if any of the above variables increases by one unit.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Characteristics of Respondents

4.1.1 Socio demographic characteristics

Table 1 shows the socio- demographic characteristics of respondents that include age, sex, education, and household size. Age of the respondents ranged from 31 to 68 years. Of the 140 respondents, 61(43.6%) were in the age range of 44 to 56 years old followed by 44 (31.4%) who were between 57 to 68 years old. Of the 140 respondents, 35 (25%) were between 31 to 43 years old.

Of the 140 respondents, 79(56.4%) were male, indicating that there were approximately equal representations of males and females who attended dairy husbandry training at LITI-Tengeru. Despite of equal opportunities provided by LITI-Tengeru and other stakeholders in dairy husbandry training, the study showed that more men were often available during training sessions. The higher men attendance during training sessions might have been attributed by the fact that, men would not allow their wives to leave household activities to attend training although majority of farming activities are done by women in the study area (Kimaro *et al.*, 2013). The dominance in managerial duties is still high in the communities, imparting knowledge and skills to women at home would make men feel respected by women, another reason could be that women were occupied by other household chorus which could not allow them to attend training.

The results are similar to those of Nzully (2007) when studying the effectiveness of KATC approaches in improving smallholders' irrigated rice productivity who found out that they were equal representation of males and females during training sessions on

improving small holder's rice productivity provided by KATC. Also, the results differ to those of Omillo *et al.* (2013) in the study on transforming women livelihoods by dairy farming and microfinance in Bunyala, western Kenya, who revealed that most farmers attended training 60 (66%) were males.

Table 1: **Socio-demographic characteristics of respondents (n=140)**

Variable	Category	n	%
Age (in years)	Between 31 to 43	35	25.0
	Between 44 to 56	61	43.6
	Between 57 to 68	44	31.4
Total		**140**	**100**
Sex	Female	61	43.6
	Male	79	56.4
Total		**140**	**100**
Education level	No formal	18	12.9
	Adult education	27	19.3
	Primary education	78	55.7
	Secondary education	15	10.7
	Tertiary	2	1.4
Total		**140**	**100**
House hold size	Between 3 to 6	79	56.4
	Between 7 to 9	60	42.9
	Between 10 to 13	1	0.7
Total		**140**	**100**

Of the 140 respondents, 78 (55.7%) had completed formal primary school training, and the remaining 27 (19.3%); 18 (12.9%); 15 (10.7%), and 2 (1.4%) had attended adult education; had no formal education, completed secondary education and tertiary level education, respectively (Table1).

Table 1 also shows that the average household had 5.32 people with a minimum of three people and maximum of 13 members of the family. The mean family size was relatively higher compared to the national household size which stands at 5.1 in rural areas (URT, 2012). However, a mean size of 2.59 people of the family in the study area was found to participate in dairy farming activities. This implied that about fifty percent of the household members were involved in other farming activities rather than dairy farming activities in the study area, the reasons would be engaged on other income generating activities like mining, business and other non-dairy activities. The results differs with those of Kinsey (2008) on the study of impact and sustainability of heifer Tanzania's in-calf credit after 23years who found that the household size of people engaged in dairy farming was five in Tanzania.

4.1.2 Socio-economic characteristics of respondents

Table 2 shows the socio-economic characteristics of the respondents. Of the 140 respondents, 95 (67.9%), 40 (28%) and five (3.5%) were found to engage in crop cultivation, crop cultivation and small business enterprise and others, respectively as complementing additional income generating activities to supplement their household requirements. Participation in off-dairy activities implies that dairy farmer can earn additional income from other sources, outside the dairy farming activities income, increases the farmers' financial capacity and increases the probability of investing on improved dairy husbandry practices (Habtemariam, 2004). It is therefore, deduced to affect adoption positively. The purpose of undertaking multi-enterprise is diversifying of production and income. Overall, off-farm work was low and comprised less than 1.4% of all the respondents (Table 2).

Lack of alternative sources of income for majority of the respondents might suggest strong reliance on agriculture related activities like dairy farming. Farmers would, therefore, be expected to demonstrate a greater ability to participate, practice and benefit from the dairy enterprise. The behavior of most respondents to undertake multi-enterprises could be an indicator of their entrepreneurial spirit among most interviewees in the study area.

Table 2: **Socio-economic characteristics of respondents (n=140)**

Variable	**Category**	**n**	**%**
Off-dairy occupation	Crop cultivation	95	67.9
	Crop cultivation and business	40	28.6
	Handcraft and crop cultivation	3	2.1
	Priest	2	1.4
Total		**140**	**100**
House hold labour in dairying	1 to 2	83	59.3
	3 to4	49	35.0
	5 to 6	8	5.7
Total		**140**	**100**
Dairy keeping Income (Tshs)	≤ 10000	107	76.4
	101-500000	32	22.9
	Above 500000	1	.7
Total		**140**	**100**
Land for dairy farming (hectare)	0.10 to 0.29	65	46.43
	0.30 to 0.40	65	46.43
	Above 0.5	10	7.14
Total		**140**	**100**

Of the 140 respondents, sixty five (46.43%) had a land size set aside for dairy farming ranging from 0.10 to 0.29 hectares. Sixty five (46.43%) and ten (7.14%) interviewees showed that land for dairy farming ranged from 0.30 to 0.40 and above 0.5 hectare,

respectively (Table2). Land size committed for dairy farming may dictate the extent of adoption of improved dairy husbandry practices bearing in mind that dairy farming is a land based venture on several activities such land for pasture establishment, construction of an improved dairy house/structure.

It revealed that the majority of respondents spared land for dairy farming below the average land size for dairy farming which is 0.85 hectare in the study area. This implies limited land allocated for pasture and fodder production, and dairy house/structure of the respondent in the study area. The results are similar to those of Mwajombe (2000) who found that pasture size plots influence towards cessation of agro forestry practices introduced. Also, Yesuf and kohlin (2008) discovered significant relationship between farm size and adoption of an innovation and that there was a positive correlation between farm size and adoption of new technologies. Onim (1992) established that small landholdings limited the farmer's choice to cultivate improved forages and dairy house/structure as most available land was used for subsistence food crops.

Of the 140 respondents, majority 107 (76.4%) earned up to Tshs 100 000 from selling dairy products per month. While 32 (22.9%) of the interviewees had income from dairy products ranging from Tshs101 000 to 500 000 per month. Only one (0.7%) respondents had earned income from dairy product above Tshs 500 000 per month (Table2).

Majority of dairy farmers in the study area relatively earned little from the sale of dairy products making trained dairy farmers being unable to purchase the recommended inputs such as supplemented feeds and covering other operational costs and this implied the cost of production were higher than output obtained hence ineffectively adoption of the trained improved dairy husbandry practices. However, according to Kai-xia *et al.* (2011) when studying factors of farmers involvement in rural social endowment insurance found

that income obtained by households from farming was not associated with farmers' adoption of the technologies.

Many studies on socio-economic characteristics, have established that these factors affect adoption of agricultural related technologies, although in some cases the directions and magnitude of the influence vary from study to study.

4.2 Improved Dairy Husbandry Practices Taught to Smallscale Dairy Farmers

From the institute curriculum of dairy husbandry course indicated that dairy farmers were trained on seven main improved dairy husbandry practices and skills includes; proper dairy feeding and feeds, dairy record keeping, construction and use of standard dairy house/structure, proper hand milking and milk hygiene, disease control and preventive measures, selection and breeding of dairy animals and the establishment of improved pasture and fodder trees (Kapinga, 2011). Also, the curriculum indicated 60 by 40 ratios of practical skills and theory training, respectively. That was taught for two weeks.

During the study, trained dairy farmers were asked to ascertain if they do recall the main improved dairy husbandry practices they were taught (Figure 3). Majority of the respondents (95%) recalled all the improved dairy husbandry practices which were taught at the training institute. Specifically, all of them (100%) recalled pasture and fodder establishment followed by proper dairy feeding and feeds (99.3%) and disease control and preventive measures (99.3%). Record keeping practice was least recalled (87.1%) (Figure 3). This implies that most of trained dairy farmers recalled the types of improved dairy husbandry practices they learned.

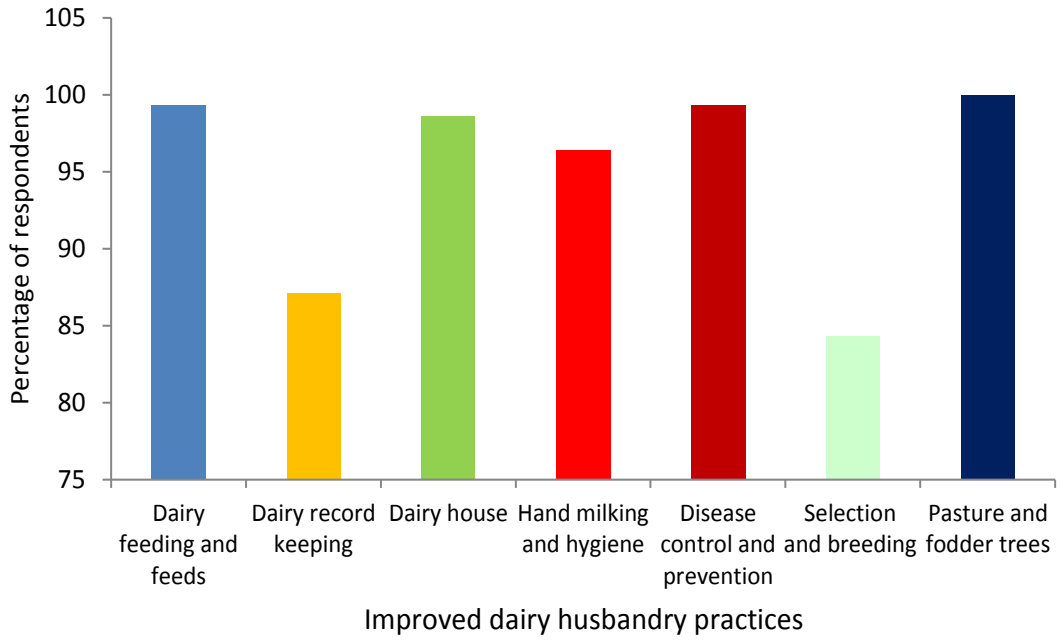

Figure 3: Respondents' distribution on recalled types of improved dairy husbandry practice learned

4.3 The Extent Trained Farmers Practiced Taught Improved Dairy Husbandry Practices

Table 3 shows that the extent of adoption of the taught practices, That is, selection and breeding, construction and use of a standard dairy house/structure, proper feed and feeding, animal health and disease control, establishing improved pastures and fodder trees and dairy farm records (record keeping).

Higher extent of adoption of taught improved dairy husbandry practices, (79.9%) was found in proper hand milking and milk hygiene practices while 76.4, 75.1, 71.4, 61.3, and 60.8% of the respondents were found to of adopt pasture and fodder establishment, Animal health status, improved animal housing, selection and breeding practices, respectively. However, the extent of adoption on Dairy farm record keeping practices was

found to be lower (49.3 %) as compared to other major improved dairy husbandry practices.

This finding differs with those of Lemma and Trived (2012) on the study of extent of adoption of improved dairy husbandry practices in Ada'a district, Ethiopia, who found the higher (68.61%) and lower (33.19%) extent of adoption for breeding and feeding practices, respectively. The variation with Ada's findings could probably be due to the fact that trained farmers in Arumeru fetch a good price for the quality milk and therefore concentrate much on milk hygiene practice.

It is shown in this study, Proper hand milking and milk hygiene practice adoption ranked first. This implies that practices that produced significant gains motivates trained farmers to adopt and practice it more effectively and efficiently by adhering to the taught ideal steps for hygiene milk production. Quality milk affects the farmer's profitability every day and producing clean milk has many positive immediate benefits to the dairy farmer. This situation may be attributed to the higher adoption score of this practice by the fact that trained dairy farmers understood that, there are some scientific precautions for the production of clean milk like washing of udder, dipping of teat to control mastitis and proper sanitation of milking parlor might have being emphasized more in training which gave obvious benefits to the farmers in return. Respondents were asked about ideal steps to follow in proper hand milking for production of clean milk accordingly.

Animal health care and disease control practices are often adopted by farmers to a good extent because of the visibility of the results. In this study Animal health care and disease control practices ranked second(Table 3), Respondents were asked questions on various preventive measures and steps for taking care of diseased animals. As revealed

from the data given in Table 3, of the seven main improved dairy husbandry practice, 74.9% of the respondents indicated to adopt animal health care and disease control practices. This is an obvious indication of direct benefits from healthier dairy animals a farmer might get.

Furthermore from Table 3, of the seven major improved dairy husbandry practices, construction and use of standard dairy house/structure practice, which comprises of the type of dairy shed/ house, feeding and drinking parlour, sewage systems waste pit, crush and walking ground had 71.2% adoption score and ranked fourth of the other improved dairy husbandry practices taught to dairy farmers. Construction and use of standard dairy house/structure is an important aspect in improved dairy husbandry, other practices such animal feeds, milk hygiene are embedded in this practice. It ranked fourth because it is a costly practice and farmers tend to focus on practices that result in immediate benefits. This finding differs with those of Mande *et al.* (2009) on his study on adoption of cattle rearing practices by dairy cattle owners in Latur district, where who found 61.1% adoption score of construction of an improved dairy house.

Table 3: The Extent trained farmers practiced taught improved dairy husbandry practices (n=140)

Improved practice	Minimum Adoption index	Maximum Adoption index	Sum	Mean Adoption index	Adoption score (%)	Rank
Breeding	0.25	1.00	85.75	0.6125	61.25	V
Dairy house/structure	0.38	1.00	99.90	0.7136	71.36	1V
Record keeping	0.00	1.00	69.17	0.4941	49.41	V11
Animal health status	0.21	1.00	105.10	0.7507	75.07	111
Pastures and fodder trees	0.00	1.00	106.92	0.7637	76.37	11
Hand milking and milk hygiene	0.38	1.00	111.99	0.7999	79.99	1
Feeds and feeding	0.00	1.00	85.15	0.6082	60.82	V1
Overall adoption index	0.26	0.96	94.77	0.6769	67.69	

Regardless of the importance on maintaining good records of dairy animals like date of birth, breeding dates, vaccinations, past health problems, treatment given, daily milk yield and other relevant data they learned, dairy record keeping practices ranked last with the lowest extent of adoption of the improved dairy husbandry practices extended to dairy farmers in the study area.

Of the seven practices, dairy record keeping practice had 49.4% adoption score (Table 3). This could be attributed by the fact that farmers need to see an immediate advantage or expected to obtain greater utility in adopting a practice. In addition, farmers must perceive that there is a problem that warrants an alternative action to be taken. Without a significant difference in outcomes between two options, and in return from alternative and conventional practices, it is less likely that farmers, especially smallscale farmers would adopt the improved practice (Musaba, 2010). Farmers may receive little long-term

benefits from record keeping practice, which might have lead them put low weight in practicing it.

From the Focus Group Discussion, the main reason for farmers not effectively practicing in record keeping was that farmers were busy with other activities; and this was basically a reflection and contributed by the multiple production system, which a crop-livestock is a mixed system, negligence and time consuming task.

The overall mean adoption index of taught improved dairy husbandry practices obtained in the study area by trained dairy farmers was found to be only 67.7% indicating that there is a still more need to follow up and backstopping by extension services on trained dairy farmers on different aspects of improved dairy husbandry practices and record keeping and feeds and feeding in particular. The findings of this study were above those of Parmar *et al.* (2009) when studying the extent of adoption of improved dairy practices by dairy farmers of Punjab, India who found only 50.5% adoption score and 54.9%, adoption score of Rathore *et al.* (2009) on the study of adoption of recommended practices and relationship between selected traits. This might have been attributed by the quality of the training received by respondents.

4.4 Socio-economic Factors Influencing Trained Farmers to Effectively Practice Learned Improved Dairy Husbandry Skills

A linear regression analysis was performed to determine the influence of predictors on the extent of adoption of improved dairy husbandry practices. The predictors(Socioeconomic Factors**)**, that is age, sex, education level, off-dairy income generating activities, household size, income from dairy keeping, land for dairying , access to credit

facilities, Extension services and study tour were regressed against the extent of adoption (adoption index).

According to Gupta (2000), beta values which are the partial regression coefficients (as optimal linear estimates of the dependent variable) reflects the weight to be applied to an independent variable when one or more specified independent variables are included in equation. And the standard error measures the dispersion of the dependent variable around its mean. The standard error is the sampling variability of partial coefficients. The t-value signifies the departure of the partial regression coefficients of independent variables from zero, and they are compared to unstandardized regression coefficient values for their statistical significant contribution to the magnitude of the dependent value. All the t-values are compared to the unstandardized regression coefficient values and yields the levels at which the observed t-value is statistically significant.

Collinearity/Multi Collinearity diagnostic were tested in order to detect whether there is correlation among the independent variables. According to Lin (2007) when there is a perfect linear relationship among the predictors, the estimate for regression model cannot be uniquely computed. The term collinearity implies that two variables are near perfect linear combinations of one another. When more than two variables are involved it is often called multicollinearity although the two terms are often interchangeably.

The Variance Inflation Factors (VIF) measures how much the variance of the estimated coefficient is increased over the case of no correlation among the independent variables. When significant multicollinearity issues exist, the Variance Inflation Factor will be very large for the variables involved. A VIF of 10 and above indicates a Multicollinearity problem. This was not observed in the results of Table 4, all independent variables have a

variance Inflation Factor (VIF) less than 10 and tolerance values (1/VIF) greater than 0.1, Hence there is no evidence of multicollinearity.

In many adoption studies, the adoption variable is binary categorized simply as adoption or non-adoption (Quddus, 2012). However, in determining the extent of adoption at the time of survey may not provide much information by categorizing into two (adoption and non-adoption) and does not adequately reflect the dynamics of a multi-component innovation such as improved dairy husbandry practices (Doss, 2006), necessitated to use continuous variable, the adoption (index) score.

Table 4 presents results of linear regression analysis with respect to the overall adoption index of 67.7% which is due to the independent variables included in the regression model. From the results, it can be deducted that the specified predictors explained the dependent variable (adoption index) by 74%. The remaining (26%) explains the error term and other factors.

Also, results in Table 4 show that regression was significant ($p \leq 0.00$) with a coefficient of determination (adjusted R^2) of 0.736 for the predictors. In linear regression setting adjustment is needed because as predictors are added to the model, some of the variations in dependent variable are explained simply by chance. The adjusted R-square in this study shows that about 74% of the variability in adoption index of improved dairy husbandry practices to trained dairy farmers is explained by socio-economic factors. That is, 74% of the obtained mean adoption index of learned improved practices by trained dairy farmers was attributed to variance shared with the optimal influence of the predictors in the model.

Table 4: Results of the linear regression model for selected predictors on adoption index of improved Dairy husbandry practices

R^2=0.76	Adjusted R^2=0.74		Std error=3.73				
Independent variable	**Unstandardized Coefficients**		**Standardized Coefficients**			**Collinearity Statistics**	
	B	**Std. Error**	**Beta**	**t value**	**Sig. level**	**Tolerance**	**VIF**
(Constant)	1.865	3.729		0.500	0.000		
AGETDF	0.036	0.031	0.059	1.156	0.250	0.730	1.370
SEXTDF	2.946	1.434	0.101	2.054	0.042*	0.791	1.265
EDUTDF	5.689	0.977	0.347	5.823	0.000**	0.540	1.853
OTHOTD	2.543	1.257	0.106	2.024	0.045*	0.695	1.439
HHSIZE	1.055	0.404	0.126	2.611	0.010**	0.820	1.220
IFDK	6.259E-6	0.000	0.052	0.818	0.415	0.480	2.081
LDA	7.156	2.428	0.138	2.947	0.004**	0.879	1.138
CRDA	-0.327	2.204	-0.008	-0.148	0.882	0.641	1.561
EXTSERB	5.171	0.880	0.345	5.877	0.000**	0.557	1.797
SDTDF	4.309	1.641	0.148	2.625	0.010**	0.604	1.656

Dependent Variable: Adoption index of improved dairy husbandry practices

* Significant at $p \leq 0.05$, ** Significant at $p \leq 0.01$

Therefore, the results in table 4 show that land size set aside for dairy farming was the highest predictor influencing trained dairy farmers in adoption of improved dairy husbandry practices effectively. From the results, land for dairy activities was positively related to the adoption index with an unstandardized regression Coefficients (β) of 7.156, Significant at 5% ($p \leq 0.01$). This implies that, a unit increase in the land size for dairy farming leads to 7.156 increase in adoption index.

For example, increase in pasture plots lead to increase in production and the overall income earned from the dairy enterprise. The results are similar to those of Mwajombe (2000) who found that resources such as land size made easier for farmers to alter husbandry practices. Similar result were found by Mafimisebi (2008) in his study on determinants and uses of farm income in Ondo State, Nigeria whose findings show that farm size was significant at ($p\leq 0.01$) with positive relation to profit margin. Additionally, improved dairy husbandry practices are scale dependant for their great importance of land size in their adoption. Therefore, the higher land size committed for dairy activities the higher possibility of effective adoption of improved dairy husbandry practices.

Table 4 shows that, Level of education of the trained dairy farmers was the second predictor to adoption of improved dairy husbandry practices they learned with an unstandardized regression coefficient of 5.689, significant at $p\leq 0.01$. This shows that the higher the education level the high chance of high extent of adoption as indicated by the model that where a unit of increase in level of education leads to a 5.689 increase in the adoption index. This implies that farmer educational background with relatively high level is thought to reduce the amount of perceived complexity in an improved dairy husbandry practice thereby increasing readiness to accept and effectively implement the improved practice; also they would be able to comprehend what they were taught hence more enhancement of adoption of the taught practices. Moreover, It is believed that more educated farmers are better off positioned to acquire information from others sources to complement the learned practice, synthesize the information and apply them to the farming situation.

The finding concurs with those of Akinbile (2003) who found that, the more literate farmers are, the more they comprehend on training and advices offered by extension agents. Furthermore, these results concur with those of Cicek, *et al*. (2007) when studying the effects of some technical and socioeconomic factors on milk production costs in Dairy enterprise in Western Turkey, who found that education level was a potential tool for determining the readiness to accept and effectively apply an innovation in dairy cattle breeding. Training on improved dairy husbandry practices to educated dairy farmers was crucial and made Dairy farmers become open –minded to follow up advice provided by extension agents.

Study tour for the purpose of supplementing the training they received on improved dairy husbandry practices was the third predictor with unstandardized regression coefficient of 4.309 significant at P≤ 0.01(Table 4). This deduced that for every unit of study tour conducted by the farmers, there is an increase of 4.309 in the adoption index. As study tour conducted, the farmers become very conversant with practice and encourage them to try more the practice to increase the extent of adoption. Also, this can be explained that, trained dairy farmers when involves in study tour increase the adoption index of a practice, so more conducting study tour to see what others dairy farmers being small holders, progressive farmers, agricultural show, field days are doing positively influencing them to effective adoption of improved dairy husbandry practices.

Furthermore, Table 4 shows that, sex was significant at P≤ 0.05 and positively influencing the adoption index with 2.946 unstandardized coefficients, this implies that the more training male dairy farmer leads to 2.946 increases in adoption index. The low adoption of improved dairy husbandry practices to female trained dairy farmers may be related to less access to household resources and to institutional services tied to long

lasting cultural and social grounds in many developing countries (Arega, 2009). The results are similar to those of Techane (2002) on the study of the determinant of technology adoption who found that household's sex has to a positive effect on adoption in favour of males.

Table 4 shows that, off-dairy enterprise generating income was significant at $p \leq 0.05$ and positively related to adoption index with an elasticity of 2.543 (unstandardized coefficient). This entails that increased unit of a trained dairy farmer involvement in more off-dairy enterprise generating income can lead to 2.543 increased in adoption of improved dairy husbandry practices. The reason for this could be that off-dairy income provides supplemental income to support improved dairy husbandry practices expenditures for example: purchase of salt block, drugs, concentrates, construction material for dairy housing, hay and small tools for dehorning and castration. This is consistent with the findings of those of Ward *et al*. (2008) when studying Factors affecting adoption of cow-calf production practices who found that off-farm income was a significant factor affecting the probability of adopting several cow-calf production practices.

Furthermore, results in Table 4 show household size was statistically significant at $P \leq 0.01$ and positively influenced the extent of adoption of improved dairy husbandry practices with an unstandardized coefficient of 1.055. This implies that, a unit increase in the household size leads to a 1.055 increase in adoption index. Households with large size are more likely to practice various improved practices as they can distribute labour into different daily operations. Labour availability is a key predictor affecting the farmer's decision to adopt innovations. Farmers with limited resources often struggle to supply sufficient labor to meet periodic labour demands that arise from Seasonal-specific dairy husbandry by requiring labour inputs at different times, a management strategy of

dairy animals' diversification can lessen labour scarcities by using family labour (Mugisha *et al.*, 2004).

The study shows that mean household is 5.32 where family members participate in dairying have a mean of 2.59, this implies that 50% of the household involve in dairy farming. Moreover Mapiye *et al*. (2006) contented that family size is the most determinant of labour investment and source of labour for family farms. Therefore, more house hold committed to dairying high effective practicing of improved dairy husbandry skills. Furthermore, Table 4 reveals that extension services to trained dairy farmers enhance farmers' understanding of the improved dairy husbandry practices hence increasing their zeal to adopt improved dairy husbandry practices. The higher frequency of contact of farmers with extension personnel, the higher are the possibilities of farmers being more influenced to adopt an agricultural innovation. An extension service provided to supplement training was found with an unstandardized regression coefficient of 5.171, and was significantly at $p \leq 0.01$.

The positive relation between extension contacts and adoption index shows that the more contact with extension personnel the more likelihood of the adoption as the model indicates that a unit increase in frequency of contact with extension staff to supplement and training backstopping on what a farmer learned leads to a 5.171 increase in the adoption index. The study results are similar to Mujuni *et al.* (2012) who found that the greater contact and availability of extension education makes a substantial contribution to motivating adoption or intensity of use of improved technologies. Also, similar findings of Dogbe (2006) who found the greater the degree of contact of farmers with extension personnel, the greater are the possibilities of farmers being influenced to adopt agricultural innovations. However, Berhanu (2002) when studying factors affecting the

adoption of cross bred dairy cows in the central highlands of Ethiopia was found no relationship between extension contact and adoption of improved husbandry practices.

Table 4 Show that, age of the respondent was found to be positively related to the adoption index though it was not significantly at $p \leq 0.05$. The high percentage of adopting of middle and older dairy farmers is further explained by the tendency of people to get involved in productive activities as they grow older. The need to cater for their demanding family drives them into looking for the profitable ventures to engage into.

A unit year increase in age leads to 0.036 increases in the adoption index of the trained dairy farmer; younger trained dairy farmers are less interested in the adoption of improved dairy husbandry practices compared to the medium and older who are more, experienced and innovative dairy farmers. This implied that middle and older dairy farmers were more likely to try improved dairy husbandry practices, evaluate and adopt them for improving dairy productivity after attained training. These results were similar to what Musaba (2010) found that older farmer with demanding family responsibilities do venture in the activities that will help to support their families.

Family responsibilities prompted older trained dairy farmers to adopt improved dairy husbandry practices than younger ones knowing that it is an economic opportunity to improve their family income to cater for family needs. Also, Omillo *et al.* (2013) on the study of transforming women livelihoods by dairy farmers and microfinance in Buyala, Western Kenya found that majority 25 (26. 9%) who were effective practicing keeping dairy animal were aged 56 years old and only 4 (4.3%) were under 40 years old. This means youths are not as committed to dairy farming as medium and older people.

Also results in Table 4 show that, a credit facility was negatively related to adoption index but insignificant. Interestingly the coefficient sign on access to credit was negative, perhaps could be attributed to the poor distribution to the sampled population (Refer Table 5). This implies that lack of access to funds in the form of loans to bring into the dairy farming it might retards the increase in the extent of adoption of the improved dairy husbandry practices to trained dairy farmers bearing in mind that majority of improved dairy husbandry practices requires high operation costs.

The results are similar to that of Agwu *et al.* (2008) who found that only 13.3% of the farmers receive agricultural credit in Nigeria, and the situation elsewhere in developing countries does not seem to differ. Also, Bulale (2000) has found in his studies of adoption production technologies in Arsi highlands that credit had no influence on adoption of dairy production technologies. However, Lack of access to credit facilities constitutes a constraint to purchase of dairy husbandry requirements hence low adoption of improved dairy husbandry practices.

4.5 Reasons Constraining Trained Dairy Farmers in Practicing the Taught Skills

Table 5 shows the respondents' reasons hindering them to implement the improved dairy husbandry practices they learned. Farmers' opinions were solicited to ascertain the reasons hindering to practice the taught skills effectively. Of the 140 respondent, 135 (96.4%) indicated that high variable cost in improved dairy breeds, construction of an improved dairy housing , buying veterinary drugs and chemicals and supplement feeds and 126 (90%) showed that insufficient extension services to backup on the learned skills were the most important reasons constraining them on effectively adopting the improved practices they learned.

However, 114 (81.4%) of respondents stated the availability of improved dairy breeds limited them to practice the skill effectively. 90 (64.3%), 83 (59.3%) opined land for pasture establishment and drought as constraining factors on the adoption of improved dairy husbandry practices they were taught, respectively. These findings were in close accordance with the most of finding of Kumar *et al.* (2012). However, the finding contradicting with Quddus (2012) on his study of adoption of dairy farming technologies by small farm holders who found that only 47.2% ascertain lack of capital for investment as the reason of not adopting technologies.

During the evaluation of the heifer project international in Tanzania, Clement *et al.* (2008) recommended that farmers training programmes should be accompanied by the initial investment to beneficiaries so that immediately after training they can start up investment on dairy house construction, buying concentrates, veterinary drugs, and frequently follow up by the area extension staff to supplement the training. These study findings concur with those of Ogola *et al.* (2010) who found that low purchasing power hinder the ability to buy inputs for effective adoption of agricultural technologies.

Table 5: Reasons constraining farmers practicing the taught skills (n=140)

Improved practices	**n**	**%**
Lack improved breeds	114	81.4
Insufficient extension services	126	90.0
Drought	83	59.3
Land for pasture	90	64.3
Running costs	135	96.4
Diseases	82	58.6
Lack of credit	119	85.0

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

From the study findings the following conclusions are drawn that farmers training have enhanced technical competency and gave more exposure to the subject matter and convinced farmers to adopt the taught improved dairy husbandry practices at a medium level.

5.1.1 Improved dairy husbandry practices taught to small scale dairy' farmers

Farmers were trained on seven major improved dairy skills including: Proper hand milking and hygiene, standard dairy house, selection and breeding, Dairy farm records, feeds and feeding, establishment of improved pasture and fodder trees, and Animal health status and preventive measures which were covered for two weeks involved 60% and 40% practical skills and theory training, respectively. Moreover, the study findings showed that 95% of the respondents recalled the types of improved dairy husbandry practices they learned.

5.1.2 The extent to which taught improved dairy husbandry skills are practiced by farmers

The overall adoption index of improved dairy husbandry practices by trained dairy farmers was only 67.7% indicating some of the taught improved dairy husbandry skills were not practiced effectively by the benefited farmers.

In general, the extent of adoption of improved dairy husbandry practices of the study group found at medium level. Practices such as proper hand milking and hygiene, animal

health status and feeds and feeding were practiced at medium to higher extent by a large number of trained dairy farmers. But, there was a low to medium level of adoption in case of standard dairy housing and record keeping practices.

5.1.3 Factors influencing trained farmers to effectively practice improved dairy husbandry skills they learned

Land size set aside for dairy farming was the highest predictor influencing adoption followed by education level, extension services, Study tour, off-dairy income generating activities, sex, and household size. The remaining predictors which included age, income from dairy farming, and credit for dairy farming did not significantly influence the observed variable of the extent of adoption taught improved dairy husbandry practices (adoption index).

5.2 Recommendations

From the study conclusions the following recommendations are made.

i. Government and NGOs should strengthen effective technical backup and advisory follow up extension services programme to supplement institute farmers training efforts.
ii. Training –extension linkage should be strengthened for effective adoption of improved dairy husbandry practices taught to dairy farmers by stakeholders.
iii. Government, NGOs and Institute should emphasize more on farmers training for improvement in adoption of improved dairy husbandry practices in general, with special emphasis on dairy farm record keeping, dairy housing, and breeding and selection practices.

iv. Introduction of improved dairy husbandry practices through farmers training should be based on a thorough analysis of the social –economic situation (land size, education level, household size, income) of the training beneficiaries.

v. Government and NGOs should facilitate and encourage farmer to farmer exchange visits, study tours, field days, and attending agricultural shows.

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APPENDICES

Appendix 1: Interview Schedule for Trained Dairy Farmers in Arumeru

FARMERS' TRAINING AND ITS INFLUENCE ON ADOPTION OF IMPROVED DAIRY HUSBANDRY PRACTICES IN ARUMERU DISTRICT, TANZANIA.

General Instructions to Enumerators

• Make brief introduction to each farmer before starting any question, get introduced To the farmers (greet them in the local way); tell them yours, the institutions you are working for, and make clear purpose and objective of study (build rapport).

• Please fill up the interview schedule according to the farmers reply (do not put your Own reply/ feeling).

• Please ask each question so clearly and patiently until the farmer understands clearly (get your points).

• Please do not try to use technical terms while discussing with the farmers (if possible, use local language for better communication).

• During the process put the answer of each respondent both on the space provided.

A: General information

(AYI) Respondent's year of training…… Interview schedule No……Interview date……Village……Ward……

Age in years	**Sex**	**Education level**	**Other occupations**
……	1.Male	1:No formal { }	**……...**
	2.Female	2:Adult education { }	
		3:Primary education { }	**……**
		4:Secondary education { }	
		5:Tertiary { }	**……**
	{ }		**……**
			……
			……

B1: What is the size of your family……..(numbers)

B2: How many participate in Dairy farming activities?.....(numbers)

B3TI: What is your estimated income…… B3IDK: from dairy keeping…….(Tshs per

B4: What is the estimated land for dairy farming…….

C: Improved dairy husbandry practices which were taught to dairy farmers (Tick)		
C1:	**W**hat were the main dairy husbandry practices did you cover during training at LITI-Tengeru?	**1**:YES 0: NO 1=Proper feed and feeding of dairy animals { } 2=Establishment of improved pasture and fodder trees { } 3=Dairy farm records { } 4=Proper hand milking and hygiene { } 5=Construction of a standard dairy house/structure { } 6=Disease control and preventive measures { } 7=Selection and breeding of dairy animals { } 8= Others (specify)…….. …….. ……

D: The extent to which taught improved dairy husbandry skills practiced.

<table>
<tr><td colspan="3">Skill: Proper feed and feeding of dairy animals</td></tr>
<tr><td>D1</td><td>How do you feed your dairy animals
1= doing it 0=not doing it</td><td>1=Natural, improved pasture and concentrates { }
2=Cut and carry pasture { }
3=Adlib water and feeds { }</td></tr>
<tr><td>D2</td><td>What are the different types of concentrates you do supplement?</td><td>
<table>
<tr><th>Type</th><th>1=YES</th><th>0=NO</th></tr>
<tr><td>D2_1 Maize bran</td><td></td><td></td></tr>
<tr><td>D2_2 Wheat bran</td><td></td><td></td></tr>
<tr><td>D2_3 Cotton cake</td><td></td><td></td></tr>
<tr><td>D2_4 Sunflower</td><td></td><td></td></tr>
<tr><td>D2_5 Molasses</td><td></td><td></td></tr>
<tr><td>D6_6 Limestone</td><td></td><td></td></tr>
<tr><td>D7_7 Dairy meal</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>D3</td><td>What the purpose of feeds for Dairy animals?</td><td>1=Maintenance { }
2=Growth { }
3= Milk production { }
4=Pregnancy { }
5=Others, Specify……</td></tr>
<tr><td colspan="3">Skill: Establishment of improved pasture and fodder trees</td></tr>
<tr><td>E1</td><td>What are the improved pastures and fodder trees you have established?</td><td>1=Grasses { }
2=Legumes { }
3=Multipurpose trees { }</td></tr>
<tr><td>E2</td><td>If you have natural pasture, Why prefer it ?</td><td>……
……..</td></tr>
<tr><td colspan="3">Skill: Dairy farm records (Record keeping)</td></tr>
<tr><td>F1</td><td>What are the major types of dairy farm record do you keep? (Probe).</td><td>1=YES 0=NO
-Breeding records { }
-Production records { }
-Feeds and feeding records { }</td></tr>
</table>

		-Health status records { }
F2	What are the main items do you include to each farm record	**Breeding records** **F2_1 B**irth date { } F2_2 Heat dates { } F2_3 Breeding dates { } F2_4 Service information { } F2_5 Expected calving date { } F2_6 Drying off date { } F2_7 Lactation number { } F2_8 Oestrus cycles { }
		Production records **F**2_9 Milk production figures { }
		Feeds and feeding records F2_10 Concentrate { } F2_11 Silage { } F2_12 Hay { }
		Health status records F2_13 Vaccination history { } F2_14 Treatment { } F2_15 Any diagnosis { } F2_16 Individual history { }
F3	If you do not keep records, give the reasons for not keeping records	**……** **……..** **…….** **……**

G: Skill: Proper hand milking

G1: What are the ideal steps to follow in dairy hand milking?

Steps for milking	1= YES	0=NO
GI_1 -Restraining the cow or get the goat onto the milk stands		
GI_2 -Washing hands, cleaning the udder and teats with clean cloth/towel soaked in warm water		
GI_3 Dries the udder with a clean dry cloth/towel to avoid moisture on the udder and teats		
GI_4 Tests the first milk to come out for mastitis (use a strip cup to check for mastitis)		
GI_5 Use of milking salve/jelly) to Lubricates the teats when milking		
GI_6 -use a teat dip to prevent mastitis		
GI_7 -Avoid noise in the dairy		
GI_8 -Clean the bucket and strainer and air dry.		

H: Skill: Construction of standard dairy house/structure			
	Standard and recommended parts to be included	**1=YES**	**0=NO**
H1_1	Stall shed		
H1_2	Holding area/raised slatted floor		
H1_3	Feeding area		
H1_4	Drinking pail/trough		
H1_5	**Sewage waste pit**		
H1_6	Milking parlour		
H1_7	Walking ground		
H1_8	Crush		

I: Skill: Animal Health Status management		
	What are the basic routine practices do you practice for ensuring biosecurity for dairy animal? -Intensive practical follow up of hygienic principles	1=YES 0=NO
I1_1	Vaccination	
I1_2	**S**praying	
I1_3	**Hoof trimming**	
I1_4	Checking mastitis	
II_5	Deworming	
II_6	Through disposal of infective / hazardous materials(Manure	
II_7	Scrupulous cleaning and disinfection/sterilization of facilities/ utensils/equipment and premises used directly/indirectly in dairy farming. { }	
II_8	Challenges/ population of parasites	
II_9	Well nourished animal	
II_10	**Shiny** animal skin	
II_11	Clean animal	
II_12	No external parasites	
II_13	Animal eats and ruminates regularly	
II_14	Animal eats and standing well	

J: Skill: Selection and breeding of the dairy animals		
J1_1	What are the main criteria do you employ in breeding	Age and weight{ }
J1_2	How do you know when your cow/doe is on heat	Observing { } Estimating the cycle { }
K	Did you get any training related to dairy husbandry before or after receiving Training from LITI-Tengeru?	1=YES 0=NO

L	If answered YES in QK, who conducted that training ? (Probe)	…… …… ……
M	Did you acquire any credit/loan as running /upkeeping cost for dairy husbandry enterprise?	1=YES 2=NO
N	If answered NO in QM above, what are the reason of not acquiring credit/loan?	1=Not available 2=Interest rate is high 3=lack of collateral
O	Do you know the village/ward livestock extension officer?	1=YES, 0=NO
P	If YES in Q.O above, do you visit him/her or visits you ?	0= not at all 1=once three month 2=once every month 3= once every week
R	Did you conduct any study tour to agricultural/ dairy farms?	1=YES 0=NO
S	If answere YES above, what are the new things you learnt during the visit which supplement the practices you were taught at LITI-Tengeru?	…… …… ……
T	What are the main factors/things hindering you in practicing the skills you were taught effectively?	…… …… ……
U	Which areas of study would you like to receive more training?	…….. ……

THANK YOU VERY MUCH FOR YOUR COOPERATION.

Appendix 2: Observational check list

<table>
<tr><td colspan="3">Skill: Proper feed and feeding of dairy animals</td></tr>
<tr><td>D1</td><td>How do you feed your dairy animals
1= doing it 0=not doing it</td><td>1=Natural, improved pasture and concentrates { }</td></tr>
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<tr><td>D6_6 Limestone</td><td></td><td></td></tr>
<tr><td>D7_7 Dairy meal</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>D3</td><td>Amount of water and feed provided per day</td><td>Adlib</td></tr>
<tr><td colspan="3">Skill: Establishment of improved pasture and fodder trees</td></tr>
<tr><td>E1</td><td>What are the improved pastures and fodder trees you have established?</td><td>1=Grasses { }
2=Legumes { }
3=Multipurpose trees { }</td></tr>
<tr><td colspan="3">Skill: Dairy farm records (Record keeping)</td></tr>
<tr><td>F1</td><td>What are the major types of dairy farm record do you keep? (Probe).</td><td>1=YES 0=NO
-Breeding records { }
-Production records { }
-Feeds and feeding records { }
-Health status records { }</td></tr>
</table>

F2	What are the main items do you include to each farm record	**Breeding records** **F2_1 B**irth date { } F2_2 Heat dates { } F2_3 Breeding dates { } F2_4 Service information { } F2_5 Expected calving date { } F2_6 Drying off date { } F2_7 Lactation number { } F2_8 Oestrus cycles { }
		Production records **F**2_9 Milk production figures { }
		Feeds and feeding records F2_10 Concentrate { } F2_11 Silage { } F2_12 Hay { }
		Health status records F2_13 Vaccination history { } F2_14 Treatment { } F2_15 Any diagnosis { } F2_16 Individual history { }

G: Skill: Proper hand milking

G1: The ideal steps to follow in dairy hand milking?

Steps for milking	1= ES	0=NO
GI_1 -Restraining the cow or get the goat onto the milk stands		
GI_2 -Washing hands, cleaning the udder and teats with clean cloth/towel soaked in warm water		
GI_3 Dries the udder with a clean dry cloth/towel to avoid moisture on the udder and teats		
GI_4 Tests the first milk to come out for mastitis (use a strip cup to check for mastitis)		
GI_5 Use of milking salve/jelly) to Lubricates the teats when milking		
GI_6 -use a teat dip to prevent mastitis		
GI_7 -Avoid noise in the dairy		
GI_8 -Clean the bucket and strainer and air dry.		

H: Skill: Construction of standard dairy house/structure			
	Standard and recommended parts to be included	**1=YES**	**0=NO**
H1_1	Stall shed		
H1_2	Holding area/raised slatted floor		
H1_3	Feeding area		
H1_4	Drinking pail/trough		
H1_5	**Sewage waste pit**		
H1_6	Milking parlour		
H1_7	Walking ground		
H1_8	Crush		

J: Skill: Selection and breeding of the dairy animals		
J1_1	What are the main criteria do you employ in breeding	Age and weight{ }
J1_2	How do you know when your cow/doe is on heat	Observing { } Estimating the cycle { }

I: Skill: Animal Health Status management		
	What are the basic routine practices do you practice for ensuring biosecurity for dairy animal? -Intensive practical follow up of hygienic principles	1=YES 0=NO
I1_1	Vaccination	
I1_2	**S**praying	
I1_3	**Hoof trimming**	
I1_4	Checking mastitis	
II_5	Deworming	
II_6	Through disposal of infective / hazardous materials Manure	
II_7	Scrupulous cleaning and disinfection/sterilization of facilities/ utensils/equipment and premises used directly/indirectly in dairy farming. { }	
II_8	Challenges/ population of parasites	
II_9	Well nourished animal	
II_10	**Shiny** animal skin	
II_11	Clean animal	
II_12	No external parasites	
II_13	Animal eats and ruminates regularly	
II_14	Animal eats and standing well	

Appendix 3: Checklist for key informants

(For Ward and District Livestock extension officers)

1. Can you give an overview of Dairy cattle/goat production in your Ward/District?
2. What are the major constraints hindering further development in dairy cattle/goat farming to farmers?
3. Can you give any significance performance in dairying for dairy farmers who received training from LITI-Tengeru
4. What are the major constraints hindering trained dairy farmers to practice improved dairy husbandry Skills they were taught?
5. What are the opportunities for the trained dairy farmers to embark on dairy farming?
6. What kind of assistance would you prefer to be extended and in cooperated in training curriculum in order to improve the current situation?
7. Are there any policy issues which need to be addressed in order to facilitate the trained dairy farmers to employ themselves?